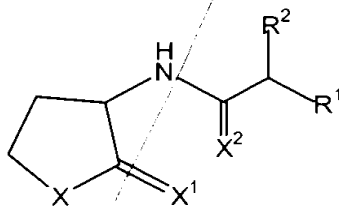


WHAT IS CLAIMED IS:

1. A compound having the structure:



wherein,

R¹ is a member selected from —H, —OH, and (=O);

R² is a member selected from H, reactive functional groups, alkyl groups terminally substituted with a reactive functional group and internally substituted alkyl groups terminally substituted with a reactive functional group;

X is a member selected from —O—, —S— and —NH—; and

X¹ and X² are members independently selected from O and S.

2. The compound according to claim 1, wherein R² is an internally substituted alkyl group terminally substituted with a reactive functional group.

3. The compound according to claim 2, wherein the alkyl group is internally substituted with a functional group that is a member selected from —OH, (=O) and combinations thereof.

4. The compound according to claim 1, wherein the reactive functional group is a member selected from —OR³, —NHR⁴, —COR⁵, —SH and —CH₂X³

wherein,

—OR³ is a member selected from hydroxy, alkyl sulfonate and aryl sulfonate groups;

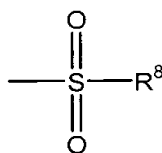
R⁴ is a member selected from H, C₁-C₆ alkyl, C₁-C₆ substituted alkyl, aryl and substituted aryl groups;

R⁵ is a member selected from H, X³ and —OR⁶, wherein R⁶ a member selected from alkyl, substituted alkyl, aryl, substituted aryl,

heteroaryl, substituted heteroaryl, heterocyclyl and substituted heterocyclyl groups; and
 X^3 is a halogen.

5. The compound according to claim 1, wherein the compound is a single stereoisomer.

6. The compound according to claim 4, wherein R^3 is



(V)

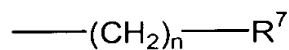
wherein,

R^8 is a member selected from alkyl, substituted alkyl, aryl and substituted aryl groups.

7. The compound according to claim 1, wherein the alkyl and the internally substituted alkyl groups are members selected from C_1 - C_{20} saturated straight-chain, C_1 - C_{20} saturated branched-chain, C_1 - C_{20} unsaturated straight-chain, C_1 - C_{20} unsaturated branched-chain alkyl and internally substituted alkyl groups.

8. The compound according to claim 7, wherein the alkyl and internally substituted alkyl groups are members selected from C_5 - C_{10} saturated straight-chain, C_5 - C_{10} saturated branched-chain, C_5 - C_{10} unsaturated straight-chain, C_5 - C_{10} unsaturated branched-chain alkyl and internally substituted alkyl groups.

9. A compound according to claim 1, wherein R^2 has the structure:



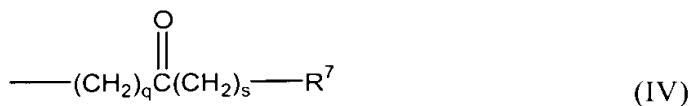
(III)

wherein,

R^7 a reactive functional group; and
 n is a number from 1 to 20, inclusive.

10. The compound according to claim 9, wherein n is a number from 2 to 9, inclusive.

11. A compound according to claim 1, wherein R^2 has the structure:



wherein,

R^7 is a reactive functional group; and

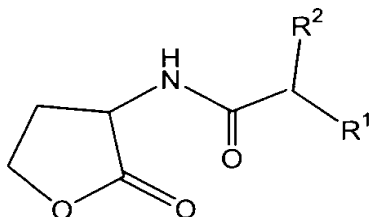
q and s are numbers independently selected from 1 to 20, inclusive.

12. The compound according to claim 11, wherein s is a number from 2 to 9, inclusive.

13. A pharmaceutical formulation comprising a pharmaceutically acceptable carrier and a compound according to claim 1, said reactive functional group of said compound being covalently bound to a biologically active agent.

14. The pharmaceutical formulation according to claim 13, wherein said biologically active agent is a member selected from antibiotics, immune stimulators and combinations thereof.

15. A compound having the structure:



(II)

wherein,

R^1 is a member selected from H, OH, and (=O); and

R^2 is a member selected from H, reactive functional groups, alkyl groups terminally substituted with a reactive functional group and internally substituted alkyl groups terminally substituted with a reactive functional group, with the proviso that when R^2 is ---OH , R^1 is a member selected from OH, and (=O).

16. The compound according to claim 15, wherein the reactive functional group is a member selected from ---OR^3 , ---NHR^4 , ---COR^5 , SH and CH_2X^3 wherein,

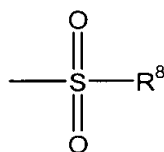
—OR³ is a member selected from hydroxy, and a species such that —OR³ is a leaving group;

R⁴ is a member selected from H, C₁-C₆ alkyl, C₁-C₆ substituted alkyl, aryl and substituted aryl groups;

R⁵ is a member selected from H, halogen and —OR⁶, wherein R⁶ is species such that —OR⁶ is a leaving group; and

X³ is a halogen.

17. The compound according to claim 16, wherein R³ is



(V)

wherein,

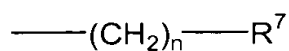
R⁸ is a member selected from alkyl, substituted alkyl, aryl and substituted aryl groups.

18. The compound according to claim 16, wherein R⁶ is a member selected from alkyl, substituted alkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclyl and substituted heterocyclyl groups.

19. The compound according to claim 15, wherein the alkyl and the internally substituted alkyl groups are members selected from C₁-C₂₀ saturated straight-chain, C₁-C₂₀ saturated branched-chain, C₁-C₂₀ unsaturated straight-chain, C₁-C₂₀ unsaturated branched-chain alkyl and internally substituted alkyl groups.

20. The compound according to claim 19, wherein the alkyl and internally substituted alkyl groups are members selected from C₅-C₁₀ saturated straight-chain, C₅-C₁₀ saturated branched-chain, C₅-C₁₀ unsaturated straight-chain, C₅-C₁₀ unsaturated branched-chain alkyl and internally substituted alkyl groups.

21. A compound according to claim 15, wherein R² has the structure:



(III)

wherein,

R⁷ is a reactive functional group; and

5 02
cat

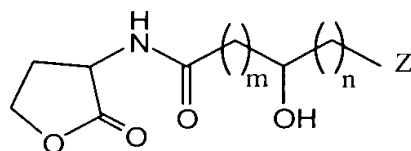
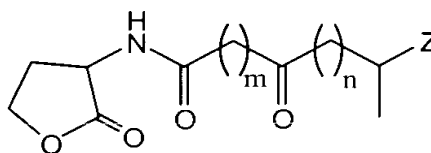
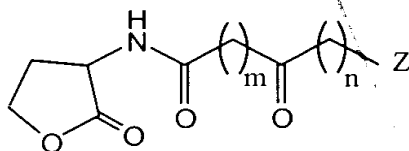
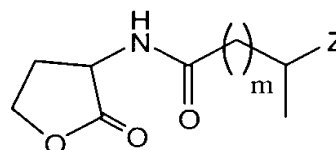
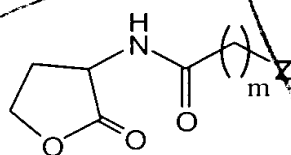
n is a number from 1 to 20, inclusive.

1 22. The compound according to claim 21, wherein n is a number from
2 2 to 9, inclusive.

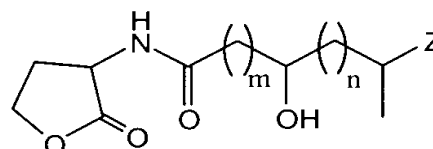
1 23. The compound according to claim 15, wherein R² is a member
2 selected from the group consisting of—COOH, —OH, —NH₂, and —SH.

1 24. The compound according to claim 21, wherein R⁷ is a member
2 selected from the group consisting of—COOH, —OH, —NH₂, and —SH.

1 546
03 25. A compound having a structure that is a member selected from:



and



wherein,

m is a number selected from 1 to 20, inclusive;

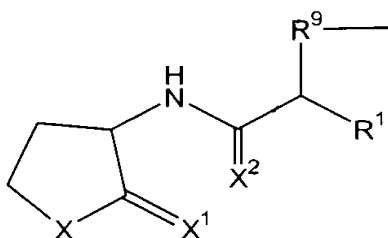
n is a number from 0 to 20, inclusive; and

Z is a reactive functional group.

1 26. The compound according to claim 25, wherein m and n are
2 numbers independently selected from 2 to 9, inclusive.

1 27. The compound according to claim 25, wherein Z is a member
2 selected from —NH₂, —COOH, —SH, and —OH.

1 **28.** An immobilized compound comprising a solid support to which is
2 attached a molecule comprising the structure:



3
4 wherein,

5 R^1 is a member selected from $-H$, $-OH$, and $(=O)$;

6 R^9 is a member selected from alkyl groups and substituted alkyl groups;

7 X is a member selected from $-O-$, $-S-$ and $-NH-$;

8 X^1 and X^2 are members independently selected from O and S.

1 **29.** The immobilized compound according to claim **28**, wherein the
2 solid support is a member selected from beads, particles, membranes, substantially planar
3 surfaces and combinations thereof.

1 **30.** The immobilized compound according to claim **28**, wherein the
2 solid support comprises a member selected from silica, metal, plastic and combinations
3 thereof

1 **31.** The immobilized compound according to claim **28**, wherein R^9
2 comprises a spacer moiety situated between the molecule and the solid support.

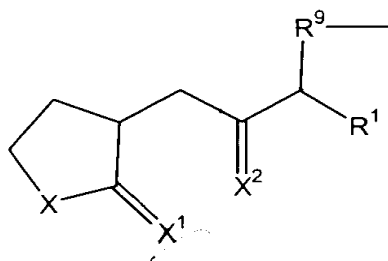
1 **32.** The immobilized compound according to claim **31**, wherein the
2 spacer moiety is selected from C_6 - C_{30} alkyl groups, C_6 - C_{30} substituted alkyl groups,
3 polyols, polyethers, polyamines, polyamino acids, polysaccharides and combinations
4 thereof.

1 **33.** The immobilized compound according to claim **31**, wherein the
2 spacer moiety comprises a cleavable moiety.

1 **34.** The immobilized compound according to claim **33**, wherein the
2 cleavable moiety is cleaved by a member selected from light, heat, oxidation, reduction,
3 enzymatic action, hydrolysis and combinations thereof.

1 35. The immobilized compound according to claim 34, wherein the
2 cleavable moiety is a member selected from disulfides and esters.

1 36. A method for isolating a microbial receptor binding to a molecule
2 comprising the formula:



(VI)

4 wherein,

5 R¹ is a member selected from —H, —OH, and (=O);

6 R⁹ is a member selected from alkyl groups and substituted alkyl groups;

7 X is a member selected from —O—, —S— and —NH—;

8 X¹ and X² are members independently selected from O and S;

9 the method comprising:

10 contacting a microbial preparation comprising the receptor with the

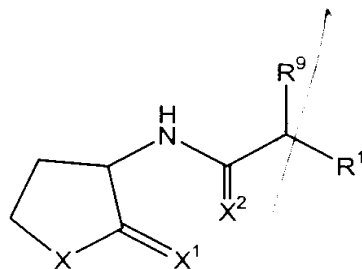
11 immobilized compound according to claim 28, thereby forming a

12 complex between the receptor and the immobilized compound.

1 37. The method according to claim 36, further comprising separating
2 the complex from components of the microbial preparation not comprising the receptor.

1 38. The method according to claim 37, further comprising disrupting
2 the complex between the immobilized compound and the receptor, thereby separating the
3 receptor from the immobilized compound.

1 39. An immunogenic conjugate comprising a target component
2 comprising the structure:



(IX)

wherein,

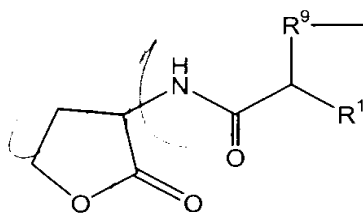
R^1 is a member selected from $-H$, $-OH$, and $(=O)$;

R^9 is a member selected from alkyl groups and substituted alkyl groups;

X is a member selected from $-O-$, $-S-$ and $-NH-$; and

X^1 and X^2 are members independently selected from O and S .

40. The immunogenic conjugate according to claim 39, wherein the target component comprises the structure:



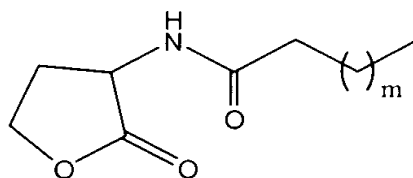
(X)

wherein,

R^1 is a member selected from H , OH , and $(=O)$; and

R^9 is a member selected from alkyl and substituted alkyl groups.

41. The immunogenic conjugate according to claim 40, wherein the target component has the structure:

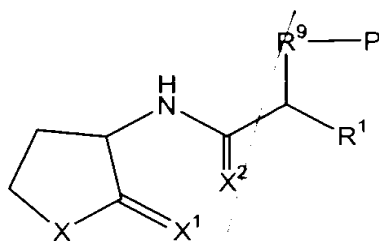


(XI)

wherein,

m is a number from 0 to 30, inclusive.

42. The immunogenic conjugate according to claim 39 having the structure:



wherein,

R^1 is a member selected from $-H$, $-OH$, and $(=O)$;

R^9 is a member selected from alkyl groups and substituted alkyl groups;

X is a member selected from $-O-$, $-S-$ and $-NH-$;

X^1 and X^2 are members independently selected from O and S ; and

P is a protein carrier.

43. The immunogenic conjugate according to claim 42, wherein the protein carrier has a molecular weight of greater than or equal to 5000 daltons.

44. The immunogenic conjugate according to claim 43, wherein the protein carrier is a member selected from albumin and hemocyanin.

45. The immunogenic conjugate according to claim 39, wherein R^9 comprises a spacer moiety situated between the target component and the protein carrier.

46. The immunogenic conjugate according to claim 45, wherein the spacer moiety is selected from C_6 - C_{30} alkyl groups, C_6 - C_{30} substituted alkyl groups, polyols, polyethers, polyamines, polyamino acids, polysaccharides and combinations thereof.

47. The immunogenic conjugate according to claim 45, wherein the spacer moiety comprises a cleavable moiety.

48. The immunogenic conjugate according to claim 47, wherein the cleavable moiety is cleaved by a member selected from light, heat, oxidation, reduction, enzymatic action, hydrolysis and combinations thereof.

49. The immunogenic conjugate according to claim 48, wherein the cleavable moiety is a member selected from disulfides and esters.

1 **50.** A pharmaceutical formulation comprising the immunogenic
2 conjugate according to claim **39** and a pharmaceutically acceptable carrier.

1 **51.** The pharmaceutical formulation according to claim **50**, wherein the
2 pharmaceutical formulation is a vaccine effective for preventing or reducing microbial
3 infection in a subject to whom the vaccine is administered.

1 **52.** An antibody that binds specifically to the immunogenic conjugate
2 according to claim **39**.

1 **53.** An isolated nucleic acid encoding the antibody according to claim
2 **52**.

1 **54.** The isolated nucleic acid according to claim **53**, further comprising
2 a promoter operably linked to the nucleic acid sequence encoding the antibody.

1 **55.** An expression vector comprising the nucleic acid according to
2 claim **53**.

1 **56.** A host cell comprising the expression vector according to claim **55**.

1 **57.** The antibody according to claim **52**, further comprising a member
2 selected from detectable labels, biologically active agents and combinations thereof
3 covalently attached to the antibody.

1 **58.** The antibody according to claim **57**, wherein the detectable label is
2 a member selected from the group consisting of radioactive isotopes, fluorescent agents,
3 fluorescent agent precursors, chromophores, enzymes and combinations thereof.

1 **59.** The antibody according to claim **58**, wherein the biologically active
2 agent is a member selected from antibiotics, immune stimulators and combinations
3 thereof.

1 **60.** A pharmaceutical formulation comprising the antibody according
2 to claim **52** and a pharmaceutically acceptable carrier.

1 **61.** A method for treating or preventing a disease in a subject caused
2 by a microorganism, the method comprising administering to the subject an amount of the
3 antibody according to claim **52** effective to reduce or prevent the disease state.

1 **62.** A method for treating or preventing a disease in a subject caused
2 by a microorganism, the method comprising administering to the subject an amount of the
3 vaccine according to claim **51** effective to reduce or prevent the disease state.

1 **63.** A method for treating or preventing a disease in a subject caused
2 by a microorganism, the method comprising administering to the subject an amount of the
3 immunogenic conjugate according to claim **39** effective to reduce or prevent the disease
4 state.

1 **64.** The method according to claim **61**, wherein the disease is a
2 microbial infection.

1 **65.** The method according to claim **62**, wherein said microbial
2 infection accompanies cystic fibrosis.

1 **66.** The method according to claim ~~74~~⁶⁴, wherein said microbial
2 infection has a causative agent comprising *P. aeruginosa*.

1 **67.** A method for preventing or disrupting the formation of a biofilm,
2 the method comprising contacting a microbial culture capable of forming a biofilm with
3 an antibody according to claim **52**.

1 **68.** The method according to claim **67**, wherein said biofilm comprises
2 *P. aeruginosa*.

1 **69.** The method according to claim **67**, wherein said biofilm is
2 associated with an implanted medical device.

1 **70.** The method according to claim **67**, wherein said biofilm is
2 associated with an organ *in vivo*.

1 71. A method for controlling autoinducer responsive gene expression
2 in a microorganism, the method comprising contacting the microorganism with an
3 antibody according to claim 52 effective to control said gene expression.

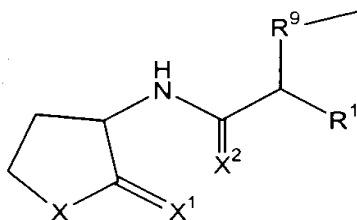
1 72. A method for controlling autoinducer responsive gene expression
2 in a microorganism, the method comprising contacting the microorganism with an
3 antibody according to claim 51 effective to control said gene expression.

1 73. A method for controlling autoinducer responsive gene expression
2 in a microorganism, the method comprising contacting the microorganism with an
3 antibody according to claim 39 effective to control said gene expression.

1 74. The method according to claim 71, wherein the microorganism is
2 bacteria.

1 75. The method according to claim 74, wherein said bacteria is *P.*
2 *aeruginosa*.

1 76. A library of compounds comprising a structure according to
2 Formula I:



3 wherein,

5 R¹ is a member selected from —H, —OH, and (=O);

6 R⁹ is a member selected from alkyl groups and substituted alkyl groups;

7 X is a member selected from —O—, —S— and —NH—;

8 X¹ and X² are members independently selected from O and S, the library
9 comprising a first compound according to Formula I and a second compound according to
10 Formula I, wherein the first compound differs from the second compound in the identity
11 of a member selected from R¹, R⁹, X, X¹, X and combinations thereof.

- 1 77. The library according to claim 76, comprising at least 10
2 compounds.
- 1 78. The library according to claim 77, comprising at least 100
2 compounds.
- 1 79. The library according to claim 78 comprising at least 1000
2 compounds.
- 1 80. The library according to claim 79 comprising at least 100,000
2 compounds.
- 1 81. A method of detecting an autoinducer in a sample, the method
2 comprising the steps of:
3 (a) contacting the sample with an antibody that specifically binds to the
4 autoinducer; and
5 (b) determining whether the sample contains the autoinducer, thereby
6 detecting said autoinducer.
- 1 82. The method of claim 81, wherein the antibody is a monoclonal
2 antibody.
- 1 83. The method of claim 81, wherein the antibody is a polyclonal
2 antibody.
- 1 84. The method of claim 81, wherein the step of determining whether
2 the sample contains an autoinducer comprises detecting the antibody in an assay selected
3 from the group consisting of an ELISA assay, a western blot, an immunohistochemical
4 assay, an immunofluorescence assay, and a real time imaging assay.
- 1 85. The method of claim 81, wherein the step of determining whether
2 the sample contains an autoinducer further comprises quantitating the amount of
3 autoinducer in the sample.
- 1 86. The method of claim 81, wherein the antibody is bound to a solid
2 substrate.

1 **87.** The method of claim **81**, wherein the sample is selected from the
2 group consisting of a cultured cell, and a patient sample.

1 **88.** The method of claim **87**, wherein the patient sample is a blood
2 sample.

1 **89.** The method of claim **87**, wherein the patient sample is from a
2 human patient.

1 **90.** The method of claim **81**, wherein the antibody is covalently linked
2 to a detectable moiety.

1 **91.** The method of claim **90**, wherein the antibody is covalently linked
2 to a member selected from a biotin moiety, a radioactive moiety, an enzyme moiety and
3 combinations thereof.

1 **92.** A method of monitoring the amount of autoinducer in a patient
2 treated with an agent that inhibits the growth of an organism producing the autoinducer,
3 the method comprising:

4 (a) providing a sample from the patient treated with the growth inhibiting
5 agent;

6 (b) contacting the sample with an antibody that specifically binds to an
7 autoinducer; and

8 (c) determining the amount of autoinducer in the patient sample by
9 detecting the antibody and comparing the amount of antibody
10 detected in the patient sample to a standard curve, thereby
11 monitoring the amount of autoinducer in the patient.

1 **93.** The method of claim **92**, further comprising the step of adjusting
2 the dose of the growth inhibiting agent administered to the patient.

1 **94.** The method of claim **92**, wherein the sample is a blood sample.

1 **95.** The method according to claim **94**, wherein said blood sample is
2 derived from a patient having cystic fibrosis and an infection comprising *P. aeruginosa*.

1 **96.** The method of claim **92**, wherein the antibody is a monoclonal
2 antibody.

1 **97.** The method according to claim **92**, wherein said antibody is a
2 polyclonal antibody.

1 **98.** The method of claim **92**, wherein the antibody is covalently linked
2 to a detectable moiety.

1 **99.** The method of claim **98**, wherein the antibody is covalently linked
2 to a member selected from a biotin moiety, a radioactive moiety, an enzyme moiety and
3 combinations thereof.

1 **100.** The method of claim **92**, wherein the antibody is bound to a solid
2 substrate.

1 **101.** A method of isolating an autoinducer, the method comprising the
2 steps of:
3 (a) providing a sample comprising the autoinducer;
4 (b) contacting the sample with an antibody that specifically binds to the
5 autoinducer, thereby forming an autoinducer-antibody complex; and
6 (c) isolating the autoinducer-antibody complex by isolating the antibody.

1 **102.** The method of claim **101**, wherein the antibody is a monoclonal
2 antibody.

1 **103.** The method of claim **101**, wherein the antibody is covalently
2 linked to member selected from a biotin moiety, a radioactive moiety, an enzyme moiety
3 and combinations thereof.

1 **104.** The method of claim **101**, wherein the antibody is bound to a solid
2 substrate.

1 **105.** A method of detecting an antibody that specifically binds to an
2 autoinducer, the method comprising the steps of:
3 (a) providing a sample;

- 4 (b) contacting the sample with a peptide that specifically binds to the
5 antibody; and
6 (c) detecting the antibody.

1 **106.** The method of claim **105**, wherein the step of detecting the
2 antibody comprises an ELISA assay.

1 **107.** The method of claim **105**, wherein the peptide is bound to a solid
2 substrate.

1 **108.** A kit for detecting an autoinducer in a sample, the kit comprising:
2 (a) an antibody that binds specifically to the autoinducer;
3 (b) directions for using the antibody to detect the autoinducer.